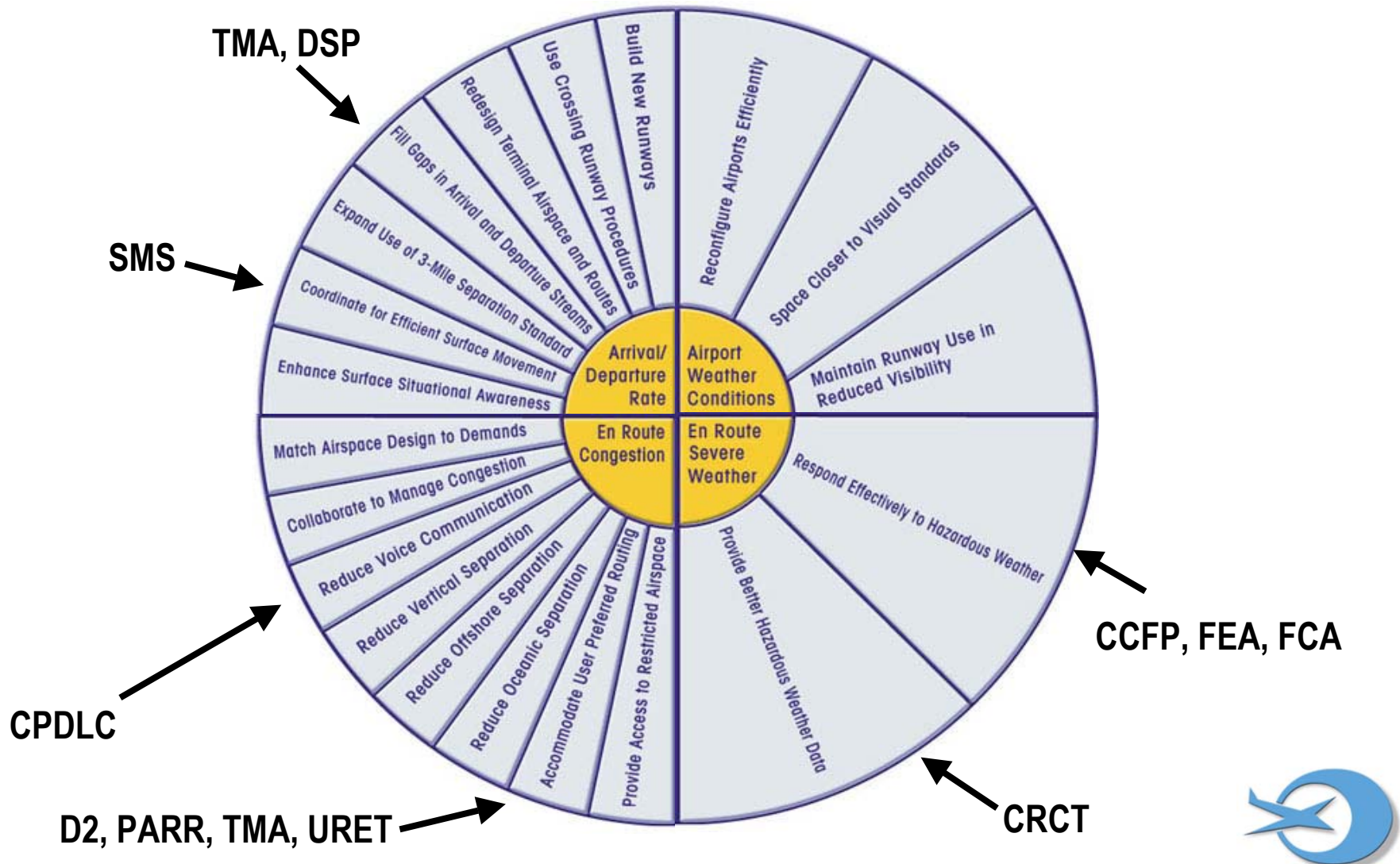




# **FREE FLIGHT AND THE OPERATIONAL EVOLUTION PLAN**

**JOHN F. THORNTON, DIRECTOR**

# Free Flight Tool Relationship to OEP Objectives



# ER7: Accommodate User Preferred Routing – The Problem

---



**Structural limitations result in under utilization of some airspace even as adjacent airspace maybe congested**

- **Controllers view of airspace is bounded by sectors for which they have jurisdiction, this limits options available...**



# ER7: Accommodate User Preferred Routing – The Solution

---



**Add strategic management tools that complement the tactical control techniques used to maintain safety**

- **User Request Evaluation Tool (URET)**
- **Traffic Management Advisor – Single Center (TMA – SC)**
- **Traffic Management Advisor – Multi Center (TMA – MC)**



# ER7: Accommodate User Preferred Routing – Status

---



## ➤ Conflict Identification and Planning: URET

Deploy URET @ FFP1 sites	2002	<i>On Schedule</i>
Deploy URET to remaining centers	2005	<i>Ahead of schedule</i>

## ➤ TMA

Deploy TMA @ FFP1 sites	2002	<i>Complete</i>
Deploy TMA @ first FFP2 sites	2003	<i>In planning</i>
Evaluate TMA – MC	2003	<i>On Schedule</i>

## ➤ Conflict Resolution and Planning Aids: Problem Analysis, Resolution and Ranking (PARR), Direct-to (D2)

Complete D2 evaluations	2004	<i>On Schedule</i>
-------------------------	------	--------------------



# ER7: Accommodate User Preferred Routing – The Benefits

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- **In Indianapolis and Memphis airspace, URET has resulted in \$1.5 million in monthly savings to industry and the removal of 20 restrictions**
  - ☐ **Time**
  - ☐ **Fuel**
  - ☐ **Environment**
- **TMA supports increased airport throughput**
  - ☐ **Minneapolis up 4 percent**
  - ☐ **Denver up 2 percent**
- **PARR and D2 will assist in the resolution of conflicts and the generation of direct routes**



# AD-4 Fill Gaps in Arrival and Departure Streams – The Problem

---



**Controllers lack automated decision support tools to extrapolate future position of aircraft to develop spacing plans and to execute those plans.**

- **Controllers now use experience and ability to extrapolate future positions of aircraft to develop spacing and metering plans**



# AD-4: Fill Gaps in Arrival and Departure Streams – The Solution

---



**Decision support tools will provide improved arrival and departure demand and available capacity. They will assist in developing improved sequencing and optimal runway balancing**

- **Departure Spacing Program (DSP)**
- **Expedite Departure Path (EDP)**
- **Traffic Management Advisor: Single Center (TMA – SC) & Multi Center (TMA – MC)**



# AD-4: Fill Gaps in Arrival and Departure Streams – Status

---



## ➤ Departure Spacing: DSP and EDP

DSP Available for New York airports		<i>Complete</i>
DSP Available at Boston and Washington Airports	<i>2002</i>	<i>Under Review</i>
EDP		<i>In Research</i>

## ➤ Metering and merge planning: TMA

Deploy TMA @ FFP1 sites	<i>2002</i>	<i>Complete</i>
Evaluate TMA – MC	<i>2003</i>	<i>On Schedule</i>
Deploy TMA @ FFP2 sites	<i>2005</i>	<i>In planning</i>
Develop Safe Flight 21		<i>In Research</i>



# AD-4: Fill Gaps in Arrival and Departure Streams – The Benefits

---



- **DSP will reduce coordination time for departures in complex airspace during severe weather situations resulting in reduced departure delays**
- **TMA metering supports delay distribution to more fuel efficient altitudes**
  - ❑ **Miami delay distribution improved significantly**
  - ❑ **Atlanta delay distribution improved at front-end rush**
- **TMA can increase arrival rates by 3-5%**
- **EDP will assist the controller in precisely metering DSP flow rates and to directly merge departures into enroute streams**



# ER3: Reduce Voice Communication – The Problem

---



**A significant portion of the controller workload is voice communications with the pilots and less than efficient use of the voice frequencies**

- **Congested voice channels can limit the effectiveness of controller-pilot communication**



# ER3: Reduce Voice Communication – The Solution

---



**Application of selective communication services over controller pilot data link communications reduces the use of en route voice communications and distributes the responsibility for communications among the sector team.**



# ER3: Reduce Voice Communication – Status

---



## ➤ Controller Pilot Data Link Communications:

Build 1 Evaluation at Miami	2002	<i>On Schedule</i>
Build 1 Operational Use at Miami	2002	<i>On Schedule</i>
National Deployment Plan	2003	<i>On Schedule</i>
Build 1A Operational at Miami or neighboring key site	2005	<i>On Schedule</i>



# ER3: Reduce Voice Communication – The Benefits

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- **Higher sector productivity**
- **Ability to accommodate the projected growth**

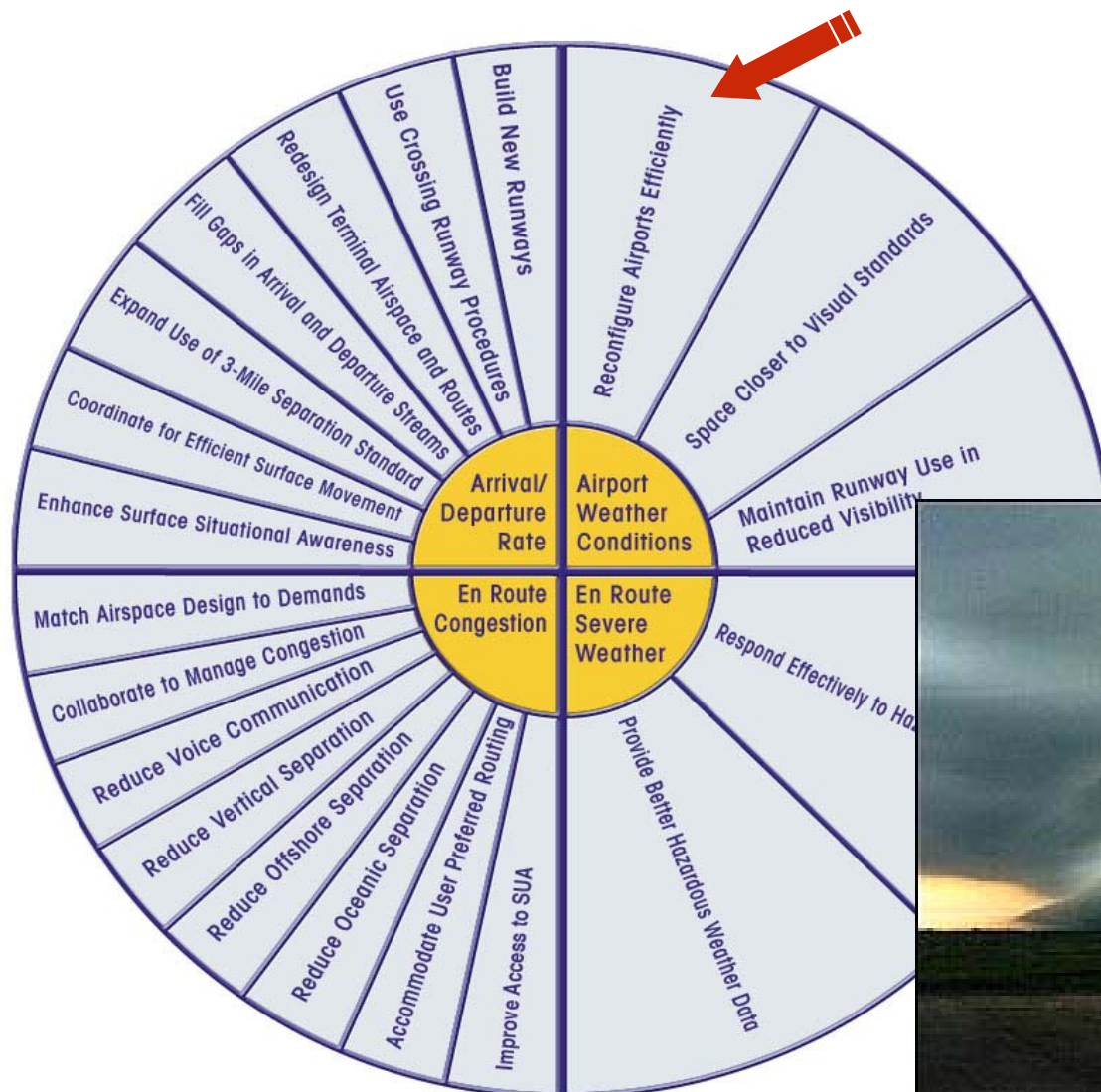




# OEP Primary Offices of Delivery

John  
Staples

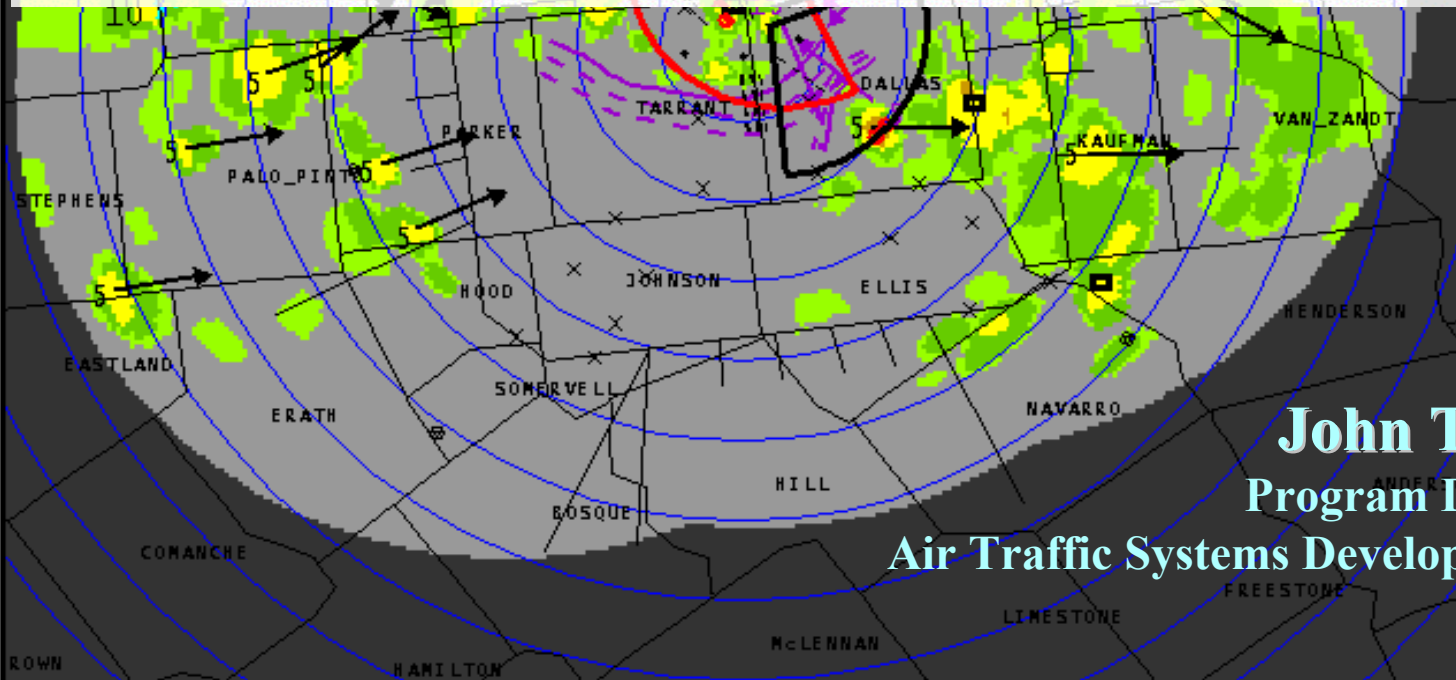
AW3





# Integrated Terminal Weather System (ITWS)

## Contribution to the Operational Evolution Plan (OEP)



**John T. Staples**  
Program Director for  
Air Traffic Systems Development, ARU





# What ITWS Provides for OEP

---

## ➤ Airport Weather Conditions

- ☐ Assists in reconfiguring airports efficiently
- ☐ Helps achieve spacing closer to visual standards during adverse wind conditions

## ➤ En Route Severe Weather

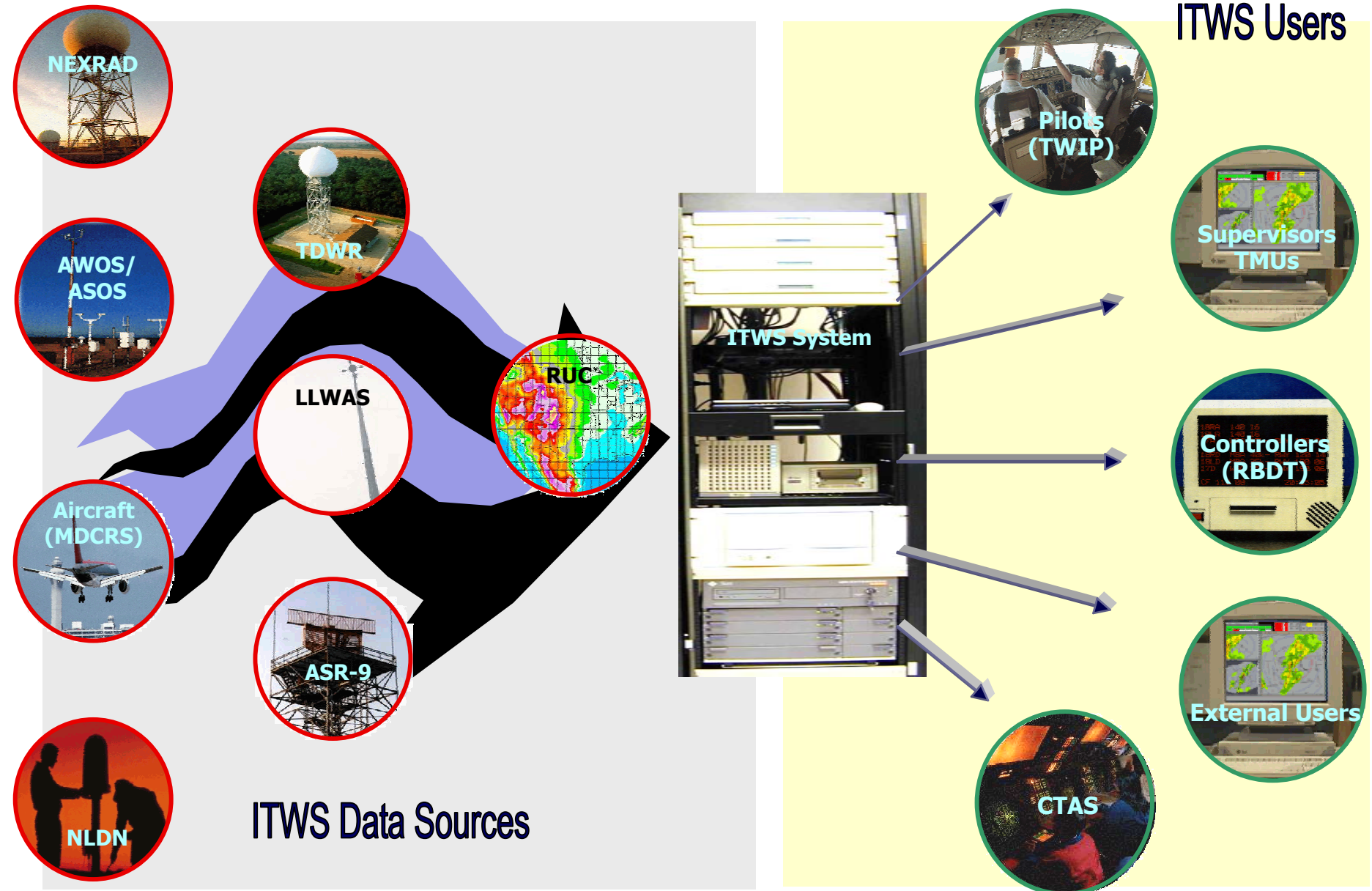
- ☐ Assists en route facilities surrounding major terminals to respond to hazardous weather
- ☐ Provides better (more timely and accurate) hazardous weather information

## ➤ Arrival/Departure Rate

- ☐ Helps fill gaps in arrival and departure streams during adverse winds and SWAPs



# ITWS Architecture





# ITWS Safety Benefits

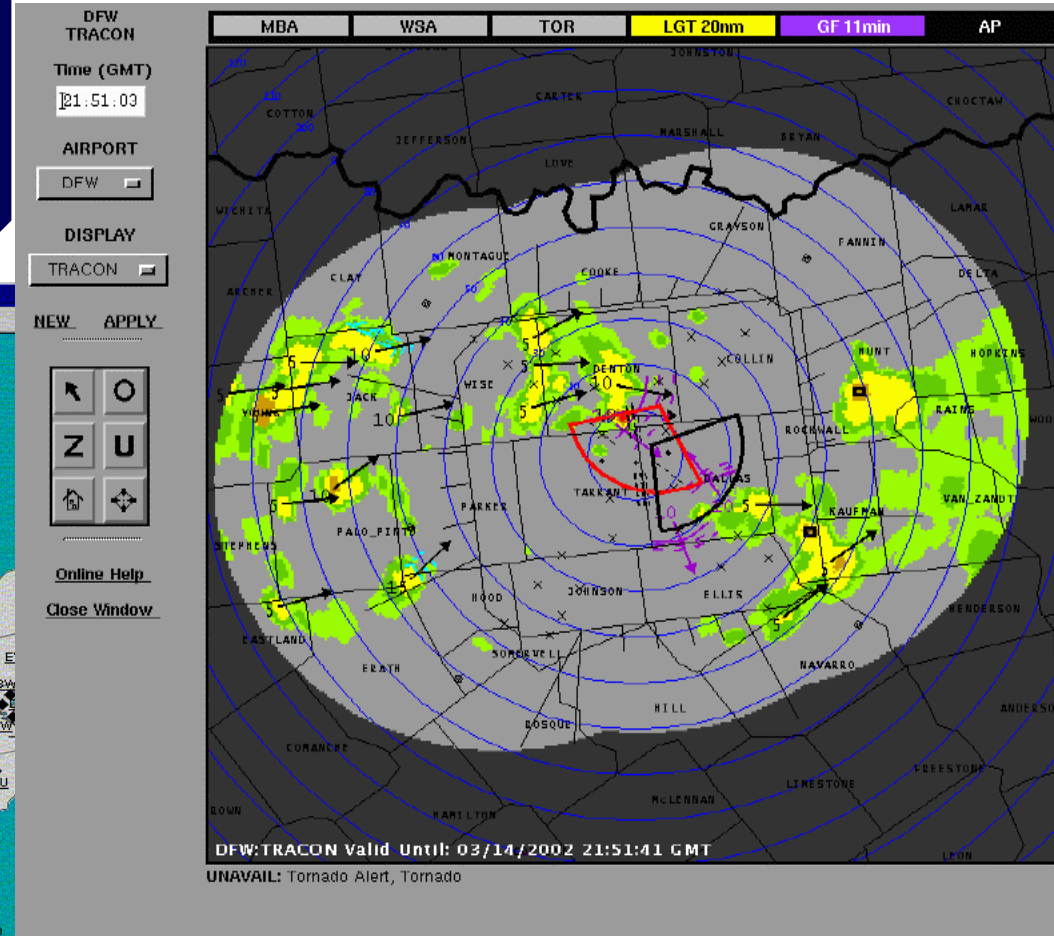
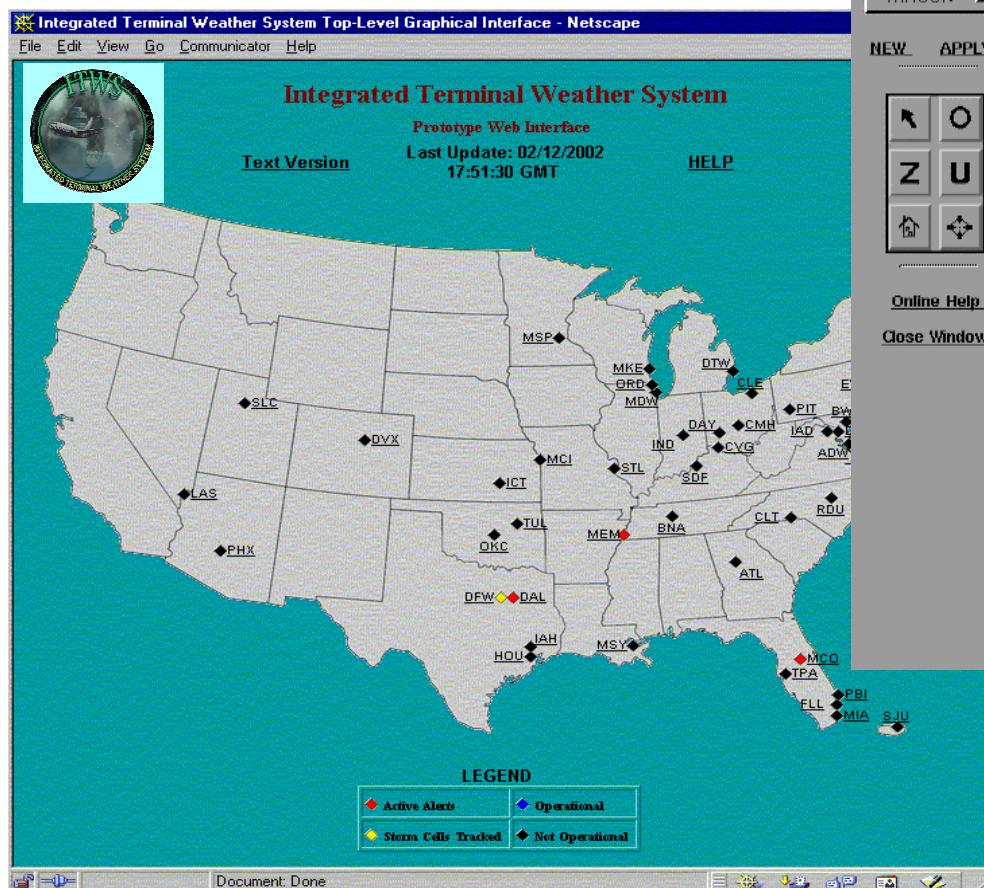
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- **Creates microburst and gust front predictions to facilitate wind shear avoidance**
- **Produces storm motion forecasts to enable FAA and airline dispatch to proactively route planes away from severe convective weather**
- **Generates timely, reliable information on rapidly changing severe weather**
- **Provides hazardous storm information and rapidly updated forecasts to airline dispatch to facilitate common situational awareness**



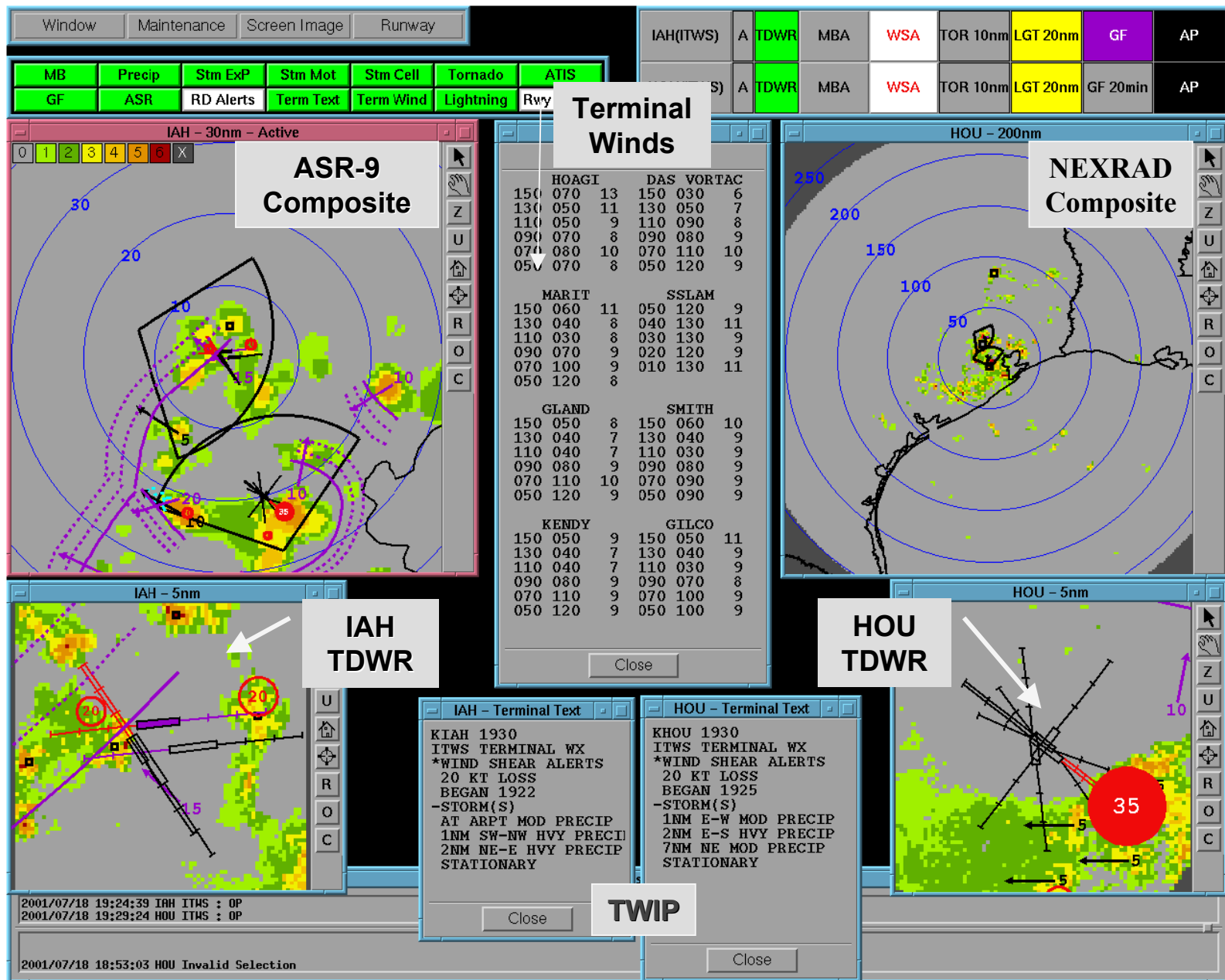
# ITWS Web Product Display Interface External Users

External Users include AOCs,  
Port/Airport Authorities, and  
will include Flight Service  
Stations



To initiate access of ITWS data, contact  
Dr. Mark Weber @ MIT: (781) 981-7958

# ITWS Air Traffic Situation Display





# Operational Experience With ITWS

---

- **Systems to be installed at 34 sites covering 47 airports**
- **Initial deployment – June 2002 (ATL)**
- **27 site-years of operational experience at FAA ITWS demonstration sites**
  - ☐ **Memphis (since 1994)**
  - ☐ **Orlando (since 1994)**
  - ☐ **Dallas (since 1995)**
  - ☐ **New York (since 1998)**
- **First article systems since 2001**
  - ☐ **Kansas City**
  - ☐ **Houston**
- **Airline access via dedicated workstations (since 1994) and Web/CDMnet servers**
- **Benefits analyses based on operational experience of users at demonstration sites**
- **Many instances where both safety and efficiency were enhanced through improved FAA and airline decisions**





# ITWS Economic Benefits

User Identified Payoff Area	Delay Reduction per Year (\$M)
Higher effective airport capacity during thunderstorm	42
Anticipating arrival and departure area closure/reopening	134
Anticipating runway impacts and shifts	94
Better terminal area traffic pattern	23
Optimizing traffic flow	137
Improved merging and sequencing in IMC conditions using terminal winds	108
Airline operations optimization (fuel, connections, ramp operation)	31
Source: MIT/LL      Total	569

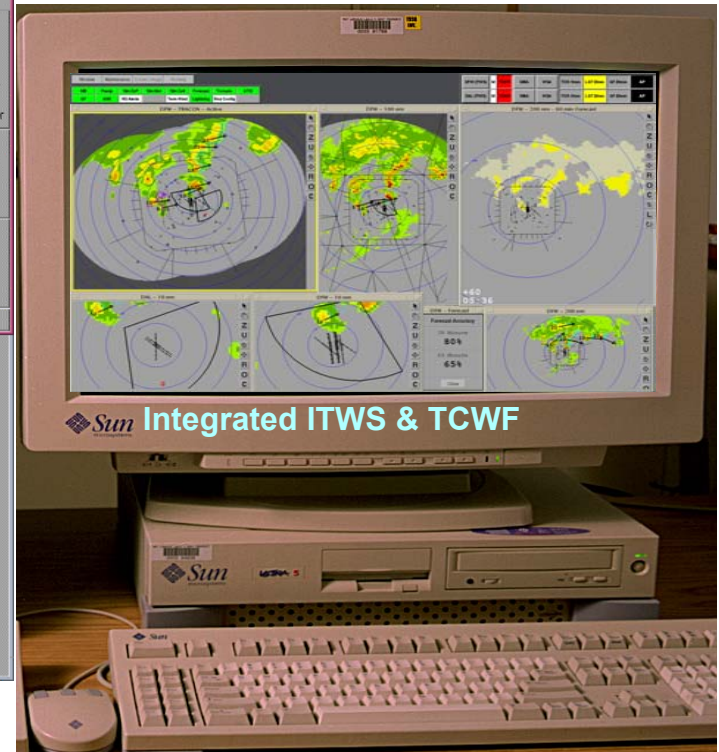
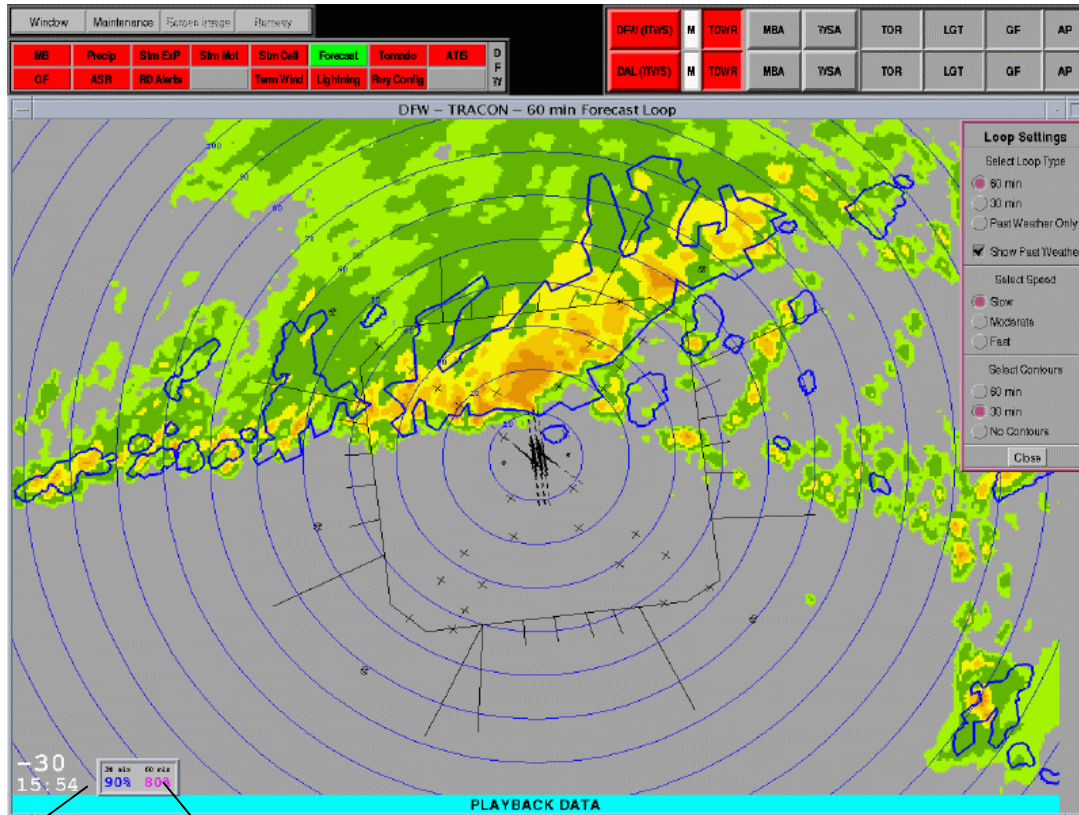
***Benefits characterized in monetary terms using FAA cost-benefits conversion.***



# Terminal Convective Weather Forecast Product (TCWF)



Technology development funded by FAA Aviation Weather Research Program (AWR)



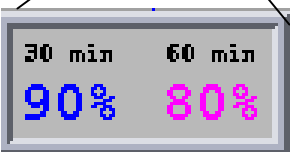
## Key features:

Animates past weather and forecast out to 60 min

**Real time scoring of past performance**

Updates every 5-6 minutes

Successful operational use at Dallas, Orlando, New York, Memphis





# Summary

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- **Adverse terminal weather (convective storms, low ceilings and visibility, and adverse winds) is a principal cause of NAS delays and reduced capacity**
- **ITWS is a key system for realizing the OEP objectives of:**
  - ❑ **Increasing capacity, and**
  - ❑ **Decreasing delays while maintaining safety**
- **In actual operational use over the past 8 years, ITWS has demonstrated the ability to safely provide a major reduction in delays**
  - ❑ **Benefits for fully deployed IOC ITWS will exceed \$ 0.5 B per year**
- **ITWS enhancements have been demonstrated that will roughly double the delay reduction provided**





# OEP Primary Offices of Delivery

John  
White  
for  
Jack Kies

ER2  
EW1/2





# **ER-2 Collaborate to Manage Congestion**

---

## **➤ Problems:**

- ☐ Balancing demand and capacity**
- ☐ Constraints to the NAS, planned and unanticipated**
- ☐ Weather impacts and ripple effect on system**
- ☐ Lack of collaboration and common situational awareness**

## **➤ Solution:**

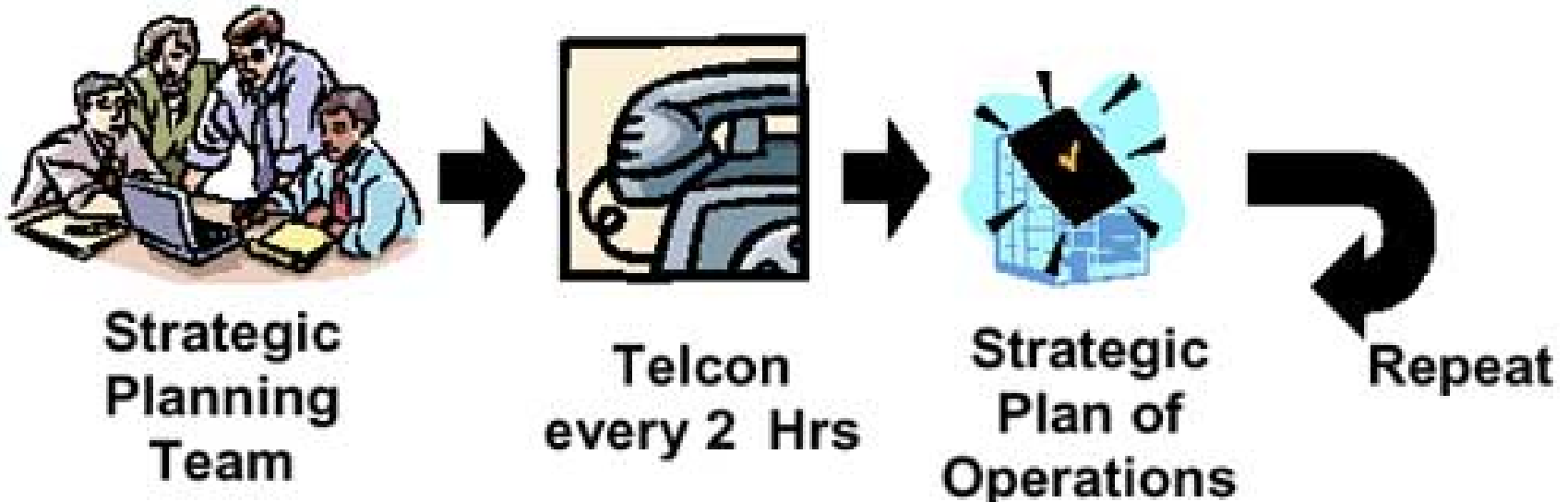
- ☐ Strategic Planning Team (SPT) process launched through the Spring/Summer 2000 (S2K) Initiative in response to user comments and FAA evaluations to improve and provide advanced system planning for system users and air traffic facilities.**
- ☐ Collaborations with the FAA field facilities and user community to develop a Strategic Plan of Operations (SPO) for known and anticipated system constraints.**

# ER-2 Collaborate to Manage Congestion (cont)



## ➤ Outcomes/Benefits:

- ☐ Maximize the utilization of the NAS in an organized and equitable manner.
- ☐ Improve transition to normal operations after a weather event through better planning.
- ☐ A comprehensive plan of action for the NAS developed collaboratively 2 to 4 hours in advance by the members of the SPT.



# **ER-2 Collaborate to Manage Congestion (cont)**

---



- **Maximize the utilization of the NAS in an organized and equitable manner through collaboration and increased communication, common situational awareness..**
- **The SPT is composed of members from :**
  - ☐ **Airline strategic planners/traffic management**
  - ☐ **FAA field facilities managers/ traffic management**
  - ☐ **ATCSCC planners**
  - ☐ **Airport Authorities**
  - ☐ **General aviation organizations**
  - ☐ **Military airspace coordinators**
  - ☐ **FAA/Airline and AWC/NWS forecasters**

# **ER-2 Collaborate to Manage Congestion (cont)**

---



## **➤ Shared Information and Technology:**

- ☐ **Collaborative Convective Forecast Product (CCFP)**
- ☐ **National Playbook**
- ☐ **Diversion Recovery Procedures**
- ☐ **ATCSCC WEB**
- ☐ **Traffic Situation Display (TSD) and Common Constraint Situational Display (CCSD)**
- ☐ **Flight Schedule Monitor (FSM)**

# **EW-1 Provide Better Hazardous Weather Data**

---



## **➤ Problem:**

- ☐ **Predictability in convective weather forecast products with respect to growth, decay, movement and thunderstorm coverage.**
- ☐ **Varied weather products and updated forecasts creating a lack of common situational awareness.**

## **➤ Solution:**

- ☐ **The Collaborative Convective Forecast Product (CCFP) was developed to provide a single convective forecast for NAS users.**
- ☐ **Airline and FAA Meteorologists provide input on the forecast for their area of responsibility via Internet.**
- ☐ **The Aviation Weather Center (AWC) takes input and produces final forecast product.**
- ☐ **Forecast is displayed on the Internet (AOC and ATCSCC web sites).**

# **EW-1 Provide Better Hazardous Weather Data (cont.)**

---



## **➤ Benefits:**

- ☐ **Provides all NAS users common situational awareness of forecasted convective activity.**
- ☐ **Improve Traffic Management route coordination during severe weather impact in the development of a strategic plan of operations.**
- ☐ **Provide opportunity for forecast input by individual NAS stakeholders through their meteorologists.**
- ☐ **More frequent and refined weather forecasts allows for airspace to be kept open longer and plan for recovery after weather has passed.**
- ☐ **CCFP feedback and analysis to improve product is under review through the Collaborative Decision Making (CDM) - Collaborative Routing (CR) Committees.**

# CCFP Graphic Display



## CCFP CONTRIBUTORS

AWC DTN NWA  
 UAL ZAU ZDC  
 ZFW ZHU ZID  
 ZKC ZME ZMP  
 ZNY ZTL

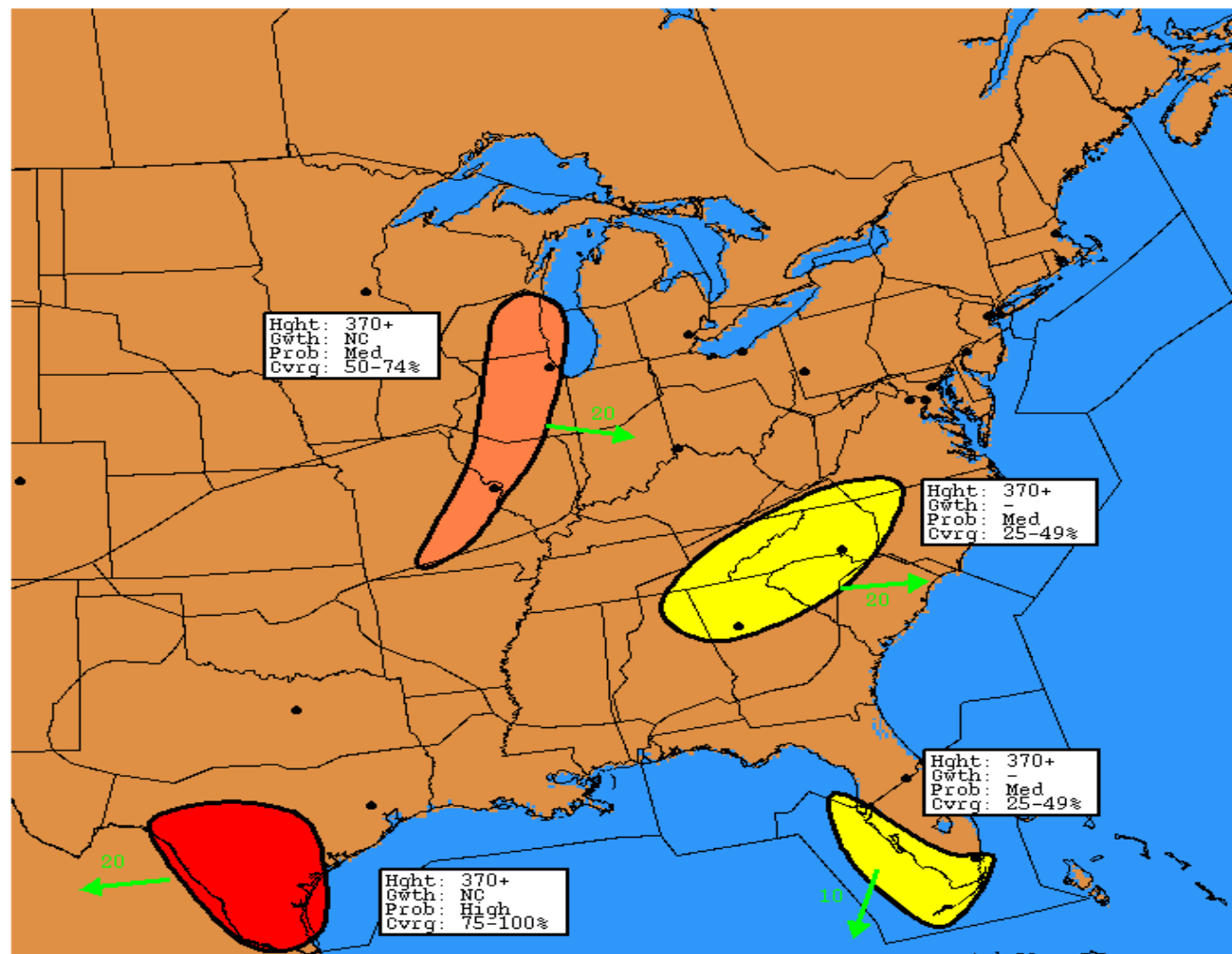
## TSTM COVERAGE AND DOWNWIND DENIED AREA:

HIGH = 74-100% ■  
 MED = 50-74% ■  
 LOW = 25-49% ■

## TOPS: 100'S OF FEET

GROWTH:  
 ++ = FAST POSITIVE  
 + = POSITIVE  
 NC = NO CHANGE  
 - = NEGATIVE

PROB OF OCCURENCE:  
 HIGH = 70 - 100%  
 MED = 40 - 69%  
 LOW = 1 - 39%



Collaborative Convective Forecast Product Valid 08/24/1999 at 22Z

# **EW-2 Respond Effectively to Hazardous Weather**

---



## **➤ Problem:**

- ☐ Flight plan route changes are workload intensive and result in increased delays and cancellations during severe weather events.**
- ☐ The inability to communicate flight plan changes in bulk for major traffic flows also slows the process.**

## **➤ Solution**

- ☐ A system of alternate air traffic routings and refined coordination procedures.**
- ☐ Coded Departure Routes (CDRs) provide precoordinated and predefined and provide alternative departure routes to avoid convective weather and allow for abbreviated clearances.**
- ☐ The National Playbook database provides pre-validated alternative routings for arrival and enroute flows. These allow for reduced coordination and implementation of routes when a resource becomes impacted.**

# **EW-2 Respond Effectively to Hazardous Weather**

---



## **➤ Benefits:**

- ☐ Activating alternative route options utilizing the National Playbook or Coded Departure Routes (CDRs) decreases the time it takes to coordinate reroutes around constraints.**
- ☐ The National Playbook is a web-based document readily accessible to National Airspace System users that identifies options to consider when planning for a severe weather event**
- ☐ Gives the FAA and NAS users will have a common resource available when discussing options.**
- ☐ Provides pre-validated solutions to quickly coordinate an alternate route when a resource becomes impacted.**
- ☐ Assists in meeting on-time departure and arrival goals.**

# **EW-2 Respond Effectively to Hazardous Weather**

---



## **➤ Benefits: ( Cont.)**

- ☐ **Improved predictability in delay, cancellation, and en-route time calculations**
- ☐ **Reduction of Mile In Trail due to efficient use of available airspace resources.**
- ☐ **Plans that are properly developed, coordinated and implemented can reduced coordination and Traffic Management flow restrictions around areas of severe weather or other system constraints.**
- ☐ **This results in better utilization of available airspace.**

# CDR Client



CDR Tool, Version: 1.07

Program

Options

Actions

Admin

CDR Tool

NFDC Tool

Input Fields: Operational

Route Code

Origin

Destination

Departure Fix

Dep. Center

Date/Time

Route String

Remarks

ModFlag

Query

Clear

New

Update

Delete

Query Results: Operational

Time	RCode	Orig	Dest	DepFix	Ro
2000-05-25 13:50:33	ORDABE0E	KORD	KABE	GIJ	KORD GIJ J163 MIP KABE
2000-03-23 17:23:22	ORDABE1N	KORD	KABE	PETTY	KORD PETTY MKG FNT CXR J146 MIP ABE
2000-06-01 15:53:22	ORDABE2S	KORD	KABE	EONE	KORD EON WORDY FWA J65 EWC PSB J78 M
2000-05-30 11:23:33	ORDABQ0W	KORD	KABQ	MZV	KORD MZV J18 LVS FRIHO3 KABQ
2000-05-30 11:41:43	ORDABQ1N	KORD	KABQ	BAE	KORD BAE J34 RWF FSD J114 DVV ALS J13 X
2000-05-30 11:40:11	ORDABQ2S	KORD	KABQ	RBS	KORD RBS CAP J80 MCI SLN J18 LVS FRIHO3
2000-03-23 17:23:22	ORDABQ3S	KORD	KABQ	RBS	KORD RBS STL J19 LVS FRIHO3 ABQ
2000-03-23 17:23:22	ORDABQ4W	KORD	KABQ	MZV	KORD MZV IRK J26 ICT J19 LVS FRIHO3 ABQ
2000-03-23 17:23:22	ORDABQ5W	KORD	KABQ	PLL	KORD PLL PLL275065 FOD J94 ONL J114 DV
2000-06-01 15:45:40	ORDADW0E	KORD	KADW	GIJ	KORD GIJ J146 WOODST J34 BLICKO8 BLICKO

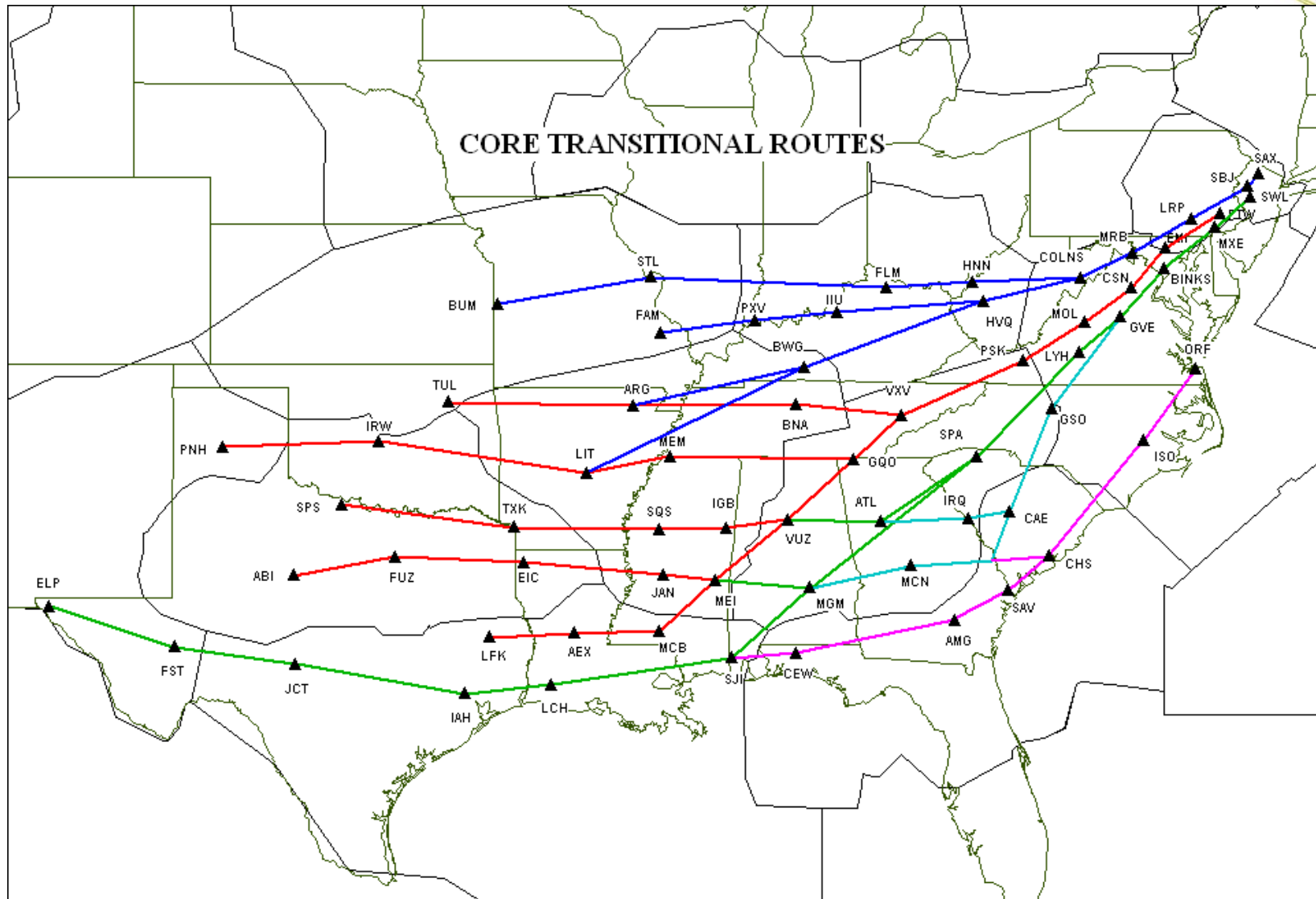
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Next

Select All

Select None



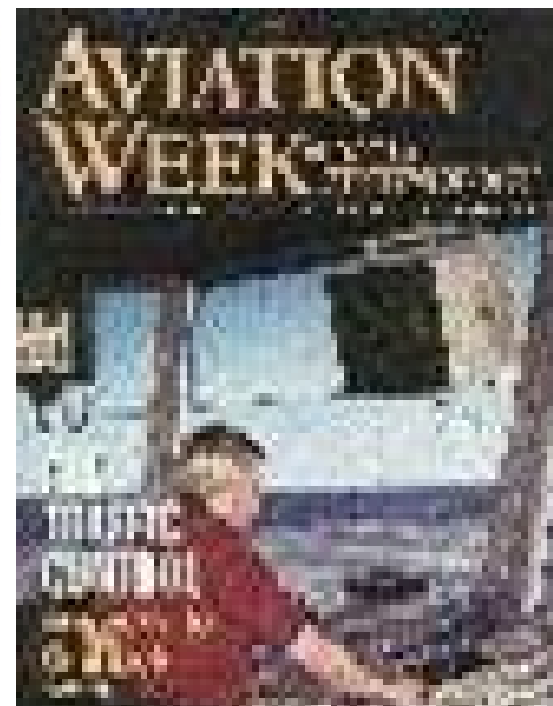


# OEP Primary Offices of Delivery



**Wilson  
Felder**  
for  
Bill Voss

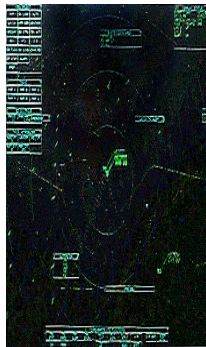
**AD6/7**



# AD-6: Coordinate for Efficient Surface Movement

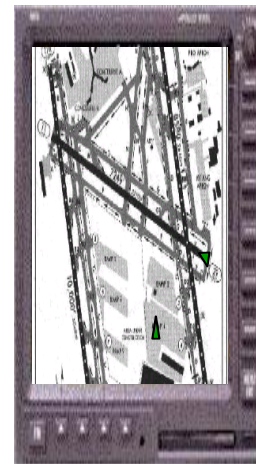
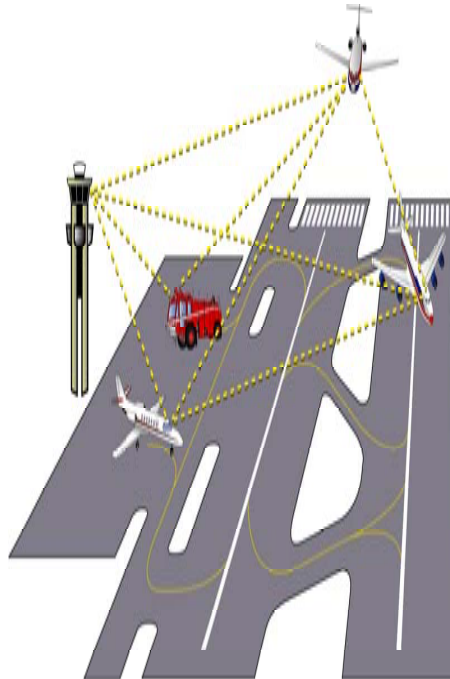


**Reduce delays by the use of new tools to display and share scheduling and situation awareness information between service providers and users.**



**Enhanced ATC  
Airport Surface  
Surveillance**

**Final Approach & Runway  
Occupancy Awareness**

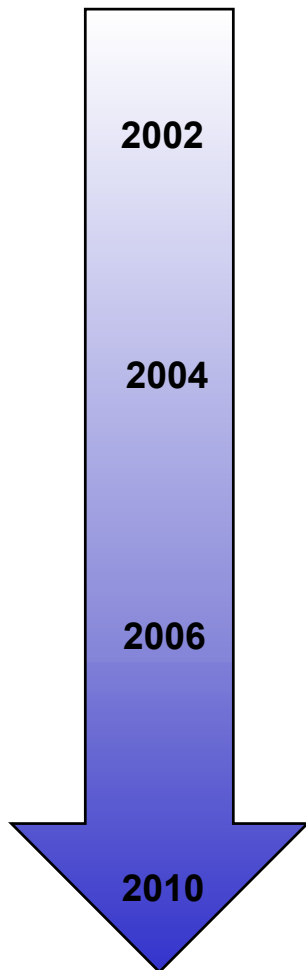


**Airport Surface Situational  
Awareness**

*Improved  
planning,  
movement, and  
decision-making  
due to shared  
situational  
awareness of  
surface  
operations.*

# AD-6 Key Milestones

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2002

NASA demonstration in Memphis

2004

SMS deployment decision

User and Ground Vehicles Equipped

2006

**Operational Surface Movement System\***

2010

\* Planned Milestone





# Solutions/Initiatives

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- **Surveillance data fusion**
  - ☐ **ADS-B and ASDE-X demo at Louisville in September 2002**
- **Extension of Collaborative Decision Making (CDM) methodology**
  - ☐ **Develop Surface Surveillance and Traffic Flow Management Data (CDM) Integration Plan**
  - ☐ **Final Interface Standards for Surface Surveillance System**
  - ☐ **Define Surface Management System (SMS) and its interfaces**
    - ✓ **Trial at Memphis (December 2003)**
    - ✓ **Independent analysis of SMS Trial (June 2004)**
  - ☐ **Incorporate Free-Flight Phase One (FFP1) Surface Movement Adviser (SMA) transitional capabilities**
  - ☐ **Deployment decision (December 2004)**
  - ☐ **Target date of December 2007 for an operational SMS**



# Metrics



- **Reduced aggregate sum of interdeparture spacing times**
- **Reduced taxi time from touchdown to gate for equipped flights compared to average for all flights (same runway, concourse, and time slot)**
  - ❑ **Taxi times and departure throughput rates serve as proxies for improved traffic flow**
- **Reduced runway incursion incident rate**
- **Fewer taxi-clearance deviations**
- **Number of aircraft in departure queue should decline and be more evenly balanced (considering departure path and user preference)**
- **Reduced number, duration, and type of ATC communications for a specific equipped flight during ground operations compared to average for all flights over same path (same time slot).**

Top level metrics affected: cost per flight, delays, total flights, passengers and cargo



# AD-7: Enhance Surface Situational Awareness

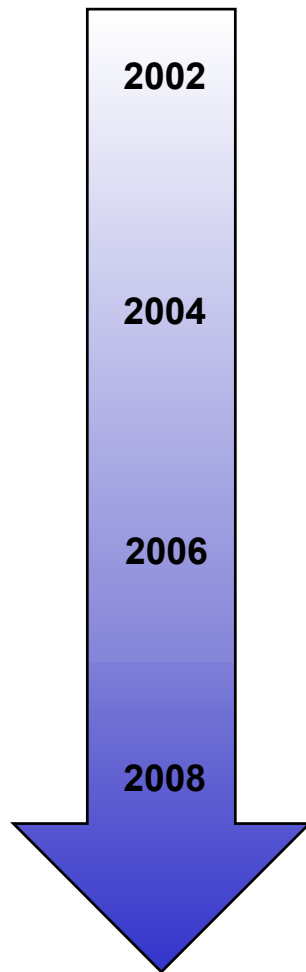


**Improve surface movement efficiency through the use of cockpit displays of moving maps**

**Final Approach, Runway and Taxiway Occupancy Awareness**



# AD-7 Key Milestones



2002

Complete Surface Operational Safety Assessment  
Test Broadcast Services at SDF

2004

Deliver Airport Surface Map Database for top 65  
Airports

2006

*Certified Avionics (moving map) as Supplemental  
Means of Navigation\**

2008

*IOC for Surface Navigation from Cockpit at Key  
Sites\**

\* Planned Milestone





# Solutions/Initiatives

---

- **Moving maps provide the same capability to tower controllers, pilots, ramp controllers, and others involved with surface operations to receive and display the same surveillance data. These maps are proposed for 59 ASDE-X sites.**
- **FAA Surface Moving Map (SMM) activities:**
  - ☐ **FAA-approved Concept of Operation – March 2002**
  - ☐ **Complete keysite activities at Louisville/Sandiford Airport (SDF), including Surface Operational Safety Assessment (November 2002)**
  - ☐ **In-service evaluation and metrics collection – September 2001-September 2005**
- **Call-sign procedure limited implementation at Memphis Airport and SDF– September 2002**
- **Deliver airport surface map database for top 65 airports – February 2003**
- **Airline Certification and Installation Plan**
  - ☐ **United Parcel Service (UPS) Supplemental Type Certification (STC) for SMM in Boeing 757 – October 2002**

# Metrics



- **Faster taxi times at night and under other reduced visibility conditions**
- **Average and excess gate times should decrease**
- **Reduced fuel burn during taxi**
  - ❑ **As calculated in the *Safe Flight-21 Cost Benefit Analysis* (May 2001), reduced taxi times could result in approximately \$3.241B in cost savings over a 20-year lifecycle.**

**Top level metrics affected: cost per flight, delays, total flights, passengers and cargo**



# WRAP UP

## 2002 Expected System Improvements



- RNAV Routes
- Dual CEDES at SFO
- SMS Trial at MEM
- Broadcast Service Test at SDF

- PRM/SOIA procedures in use
- ITWS production unit in ATL



- Remaining Choke Point Sectors
- CDM Annual Cycle Improvement
- CPDLC Build 1 Miami
- More URET Sites
- Completion of Restricted Airspace Solution Set

- RUC20 Improved Forecast
- Diversion Recovery Tool operational
- EDTC +/- 5 Minutes Trials
- CIWS Evaluations
- ETMS Modernization